RuggedSwitch™ RS900L

8-Port Managed Ethernet Switch with EoVDSL Uplinks

Installation Guide

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Federal Communications Commission
Radio Frequency Interference Statement

This equipment has been tested and found to comply with the limits for a Class A digital device pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his expense.

Caution

This product contains a laser system and is classified as a "CLASS 1 LASER PRODUCT".

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Should this device require service see the "Warranty" section of this installation guide.

Important

This unit should be installed in a restricted access location where access can only be gained by service personnel or users who have been instructed about the reasons for the restrictions applied to the location and about any precautions that shall be taken; and access is through the use of a tool or lock and key, or other means of security, and is controlled by the authority responsible for the location.

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1 Product Overview

1.1 Functional Overview

The RuggedSwitch RS900L is an 8 port industrially hardened, fully managed Ethernet switch supporting Ethernet over VDSL allowing up to 2.5 km LAN segments over telephone grade cable at up to 35 Mbps. The RS900L has one EoVDSL port plus two optional fiber optic ports allowing a cascaded Ethernet network to span hundreds of kilometers over any combination of telephone and fiber optic cable. It is the perfect solution for bringing Ethernet networking to applications where telephone wiring is already present and saving the considerable cost of installing new fiber.

1.2 Feature Highlights

- Ethernet Ports
  - 1 EoVDSL port
  - 6 10/100Base-TX ports
  - 2 Optional Fiber Optic ports
- EoVDSL port characteristics:
  - Software selectable to be master or slave
  - Symmetric data rates up to 35 Mbit/s
  - Automatically selects fastest data rate based on distance and quality of cable
  - Manual speed configuration available

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1.3 Front Panel Description

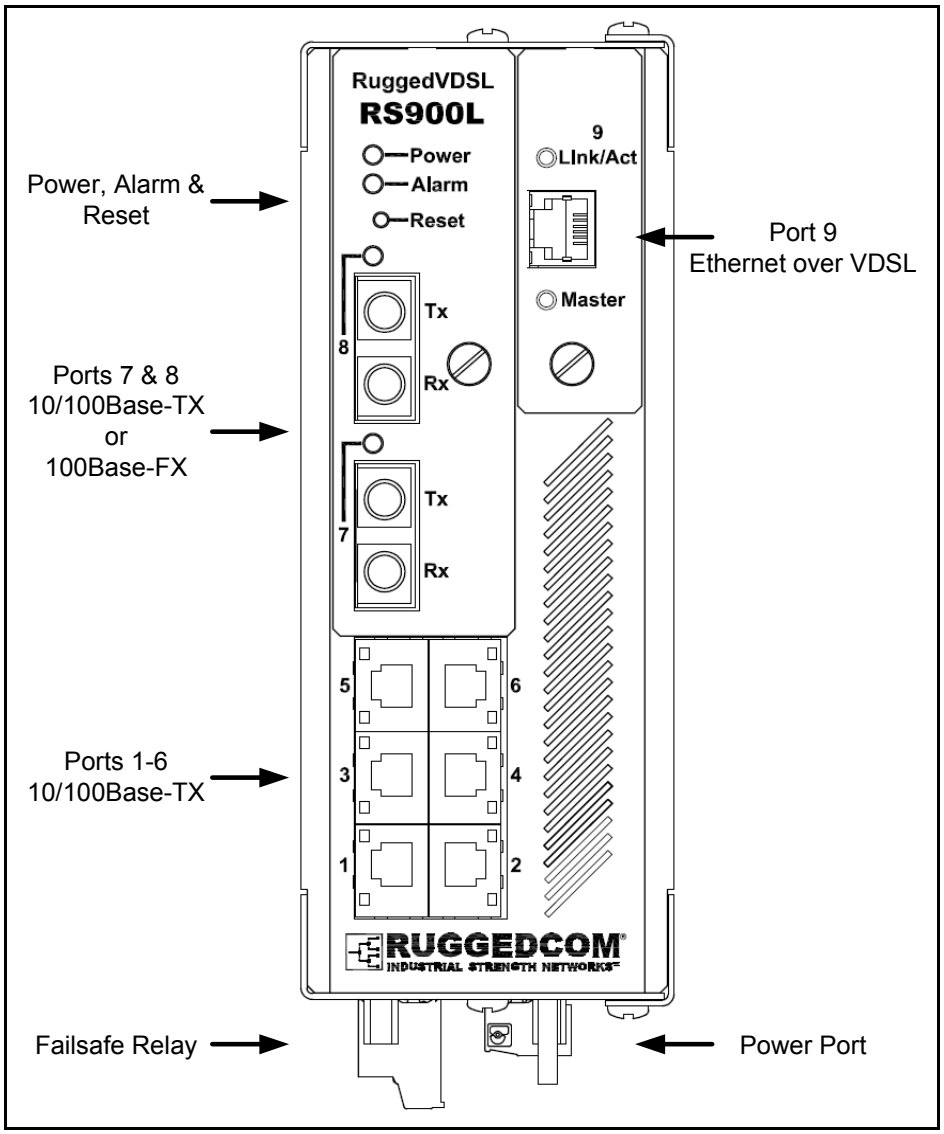

Figure 1 - Front Panel Description

Status LED	Colour	Activity	Comments
Power LED	Green	Solid	Power On
Alarm LED	Red	Solid	Alarm condition exists

Table 1 - Status LEDs

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1.4 Bottom Panel Description

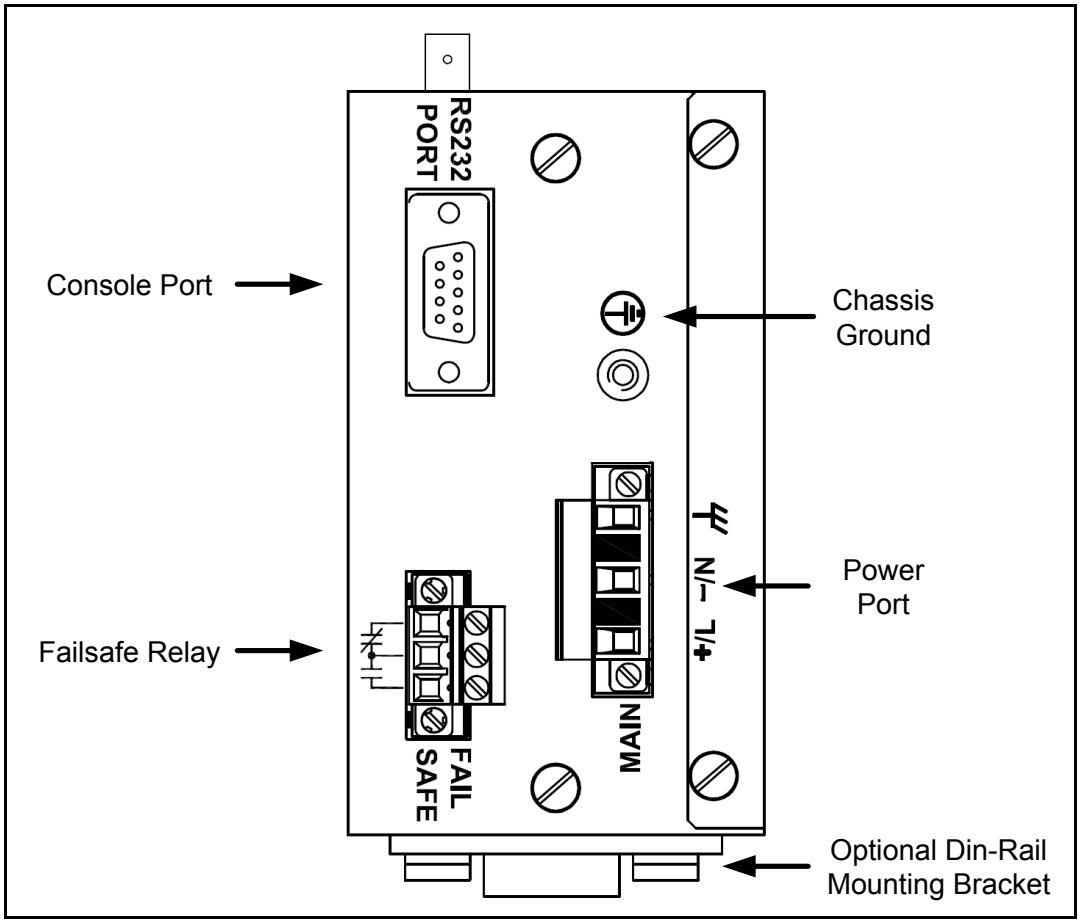

Figure 2 - Bottom Panel Description

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2 Installation

2.1 Din Rail Mounting

An optional DIN rail-mounting bracket is available for the unit. The figure below details mounting instructions for the standard 1" DIN Rail.

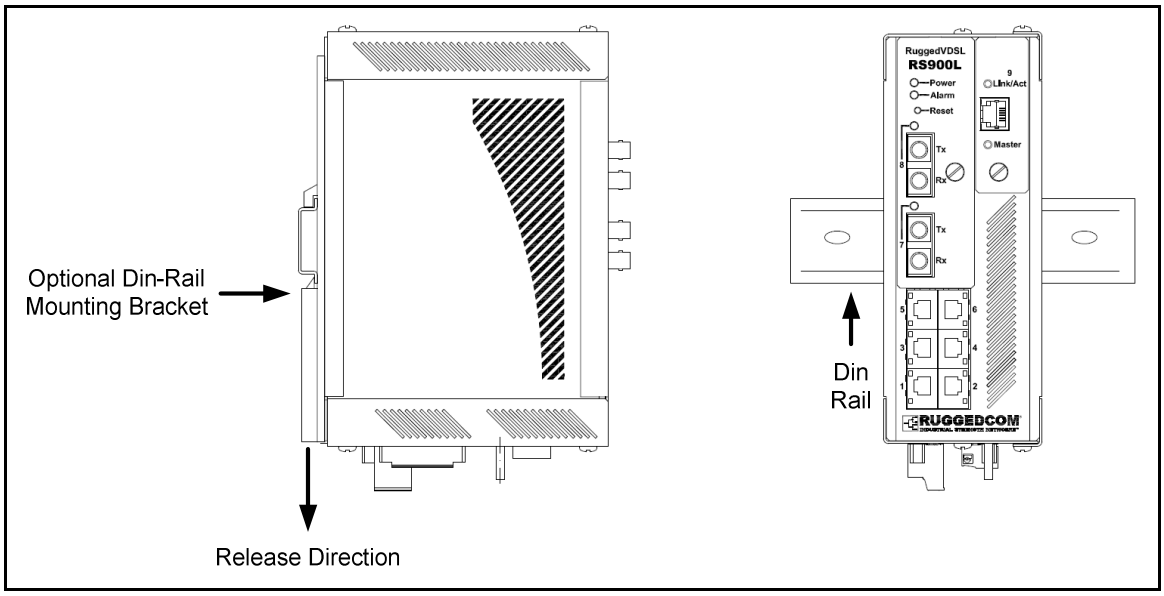

Figure 3 - DIN Rail Mounting

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2.2 Power Supply Wiring and Grounding

2.2.1 AC Power Supply Wiring and Grounding

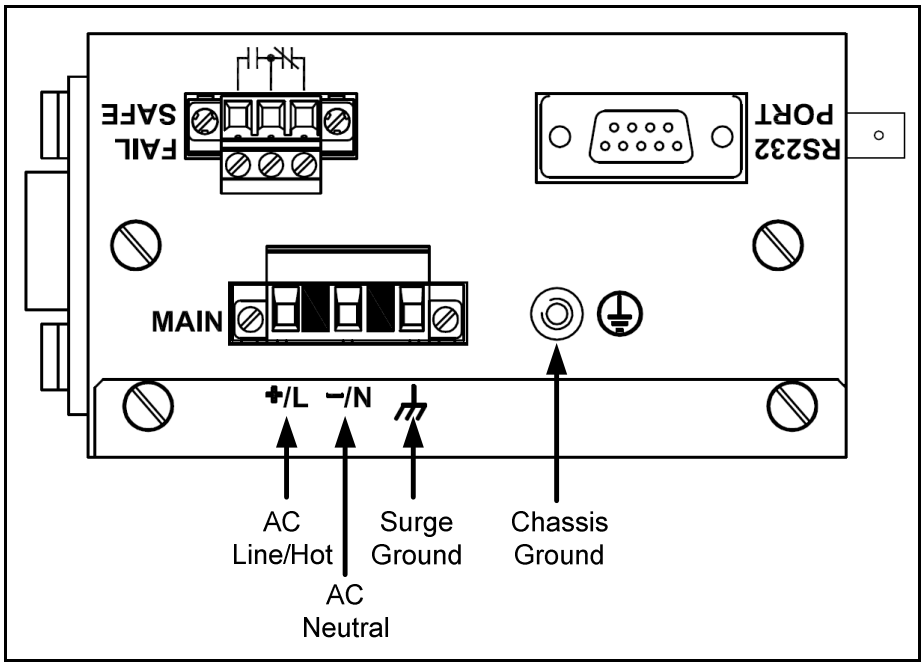

Figure 4 - Power Supply Inputs

The AC power supply inputs should be connected as follows:

1. +/L should be connected to AC Line/Hot.
2. -/N should be connected to AC Neutral.
3. Surge Ground should be connected to the Chassis Ground via a braided cable or other appropriate grounding wire. Surge Ground is used as the ground conductor for all surge and transient suppression circuitry internal to the unit.
4. Chassis Ground must be connected to the AC ground terminal.

NOTES:

1. Equipment must be installed according to the applicable country wiring codes.
2. All line-to-ground transient energy is shunted to the Surge Ground terminal. In cases where users require the inputs to be isolated from ground, remove the ground braid between Surge and Chassis Ground. Note that all line-to-ground transient protection circuitry will be disabled.

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2.2.2 DC Power Supply Wiring and Grounding

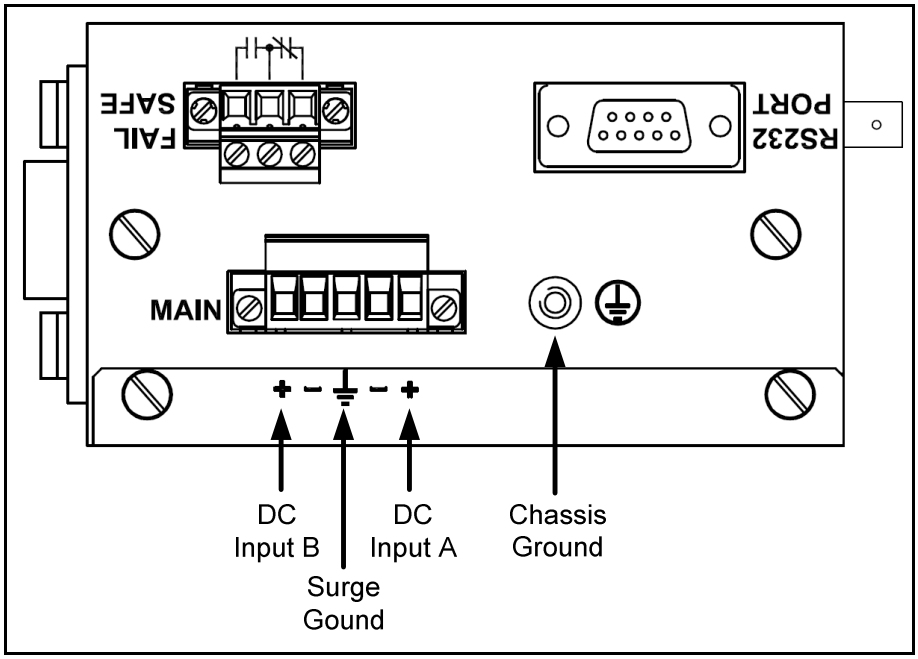

Figure 5 - DC Power supply wiring and grounding diagram

The low voltage DC power supply features reverse polarity protection and dual independent inputs. The latter feature allows the connection of two DC sources with the same nominal voltage to provide redundant power supply inputs.

The DC power supply inputs should be connected as follows:

1. Connect to the DC inputs according to the polarity markings on the unit.
2. Surge Ground should be connected to the Chassis Ground via a braided cable or other appropriate grounding wire. Surge Ground is used as the ground conductor for all surge and transient suppression circuitry internal to the unit.
3. Chassis Ground must be connected to the protective earth.

NOTES:

1. Equipment must be installed according to the applicable country wiring codes.
2. All line-to-ground transient energy is shunted to the Surge Ground terminal. In cases where users require the inputs to be isolated from ground, remove the ground braid between Surge and Chassis Ground. Note that all line-to-ground transient protection circuitry will be disabled.

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2.2.3 Failsafe Output Wiring

The Failsafe output relay is provided to signal critical error conditions that may occur on the unit. The contacts are energized upon power up of the unit and remain energized until an alarm condition or power loss occurs. The behavior of the failsafe relay is configurable via the RuggedSwitch Operating System. Consult the RuggedSwitch Users Guide for details.

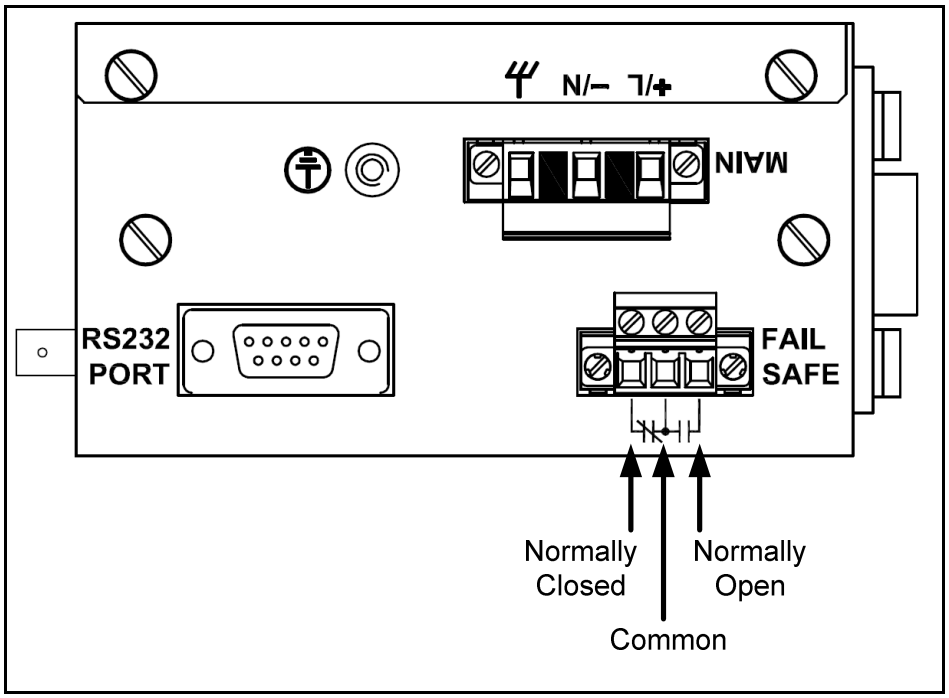

Figure 6 - Failsafe Output Relay

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2.2.4 Dielectric Strength Testing

Units which are to have dielectric strength testing (HIPOT testing) done in the field must have the braided ground cable disconnected during the test. This is required in order to prevent the surge suppression circuitry, which is connected to surge ground, from being activated.

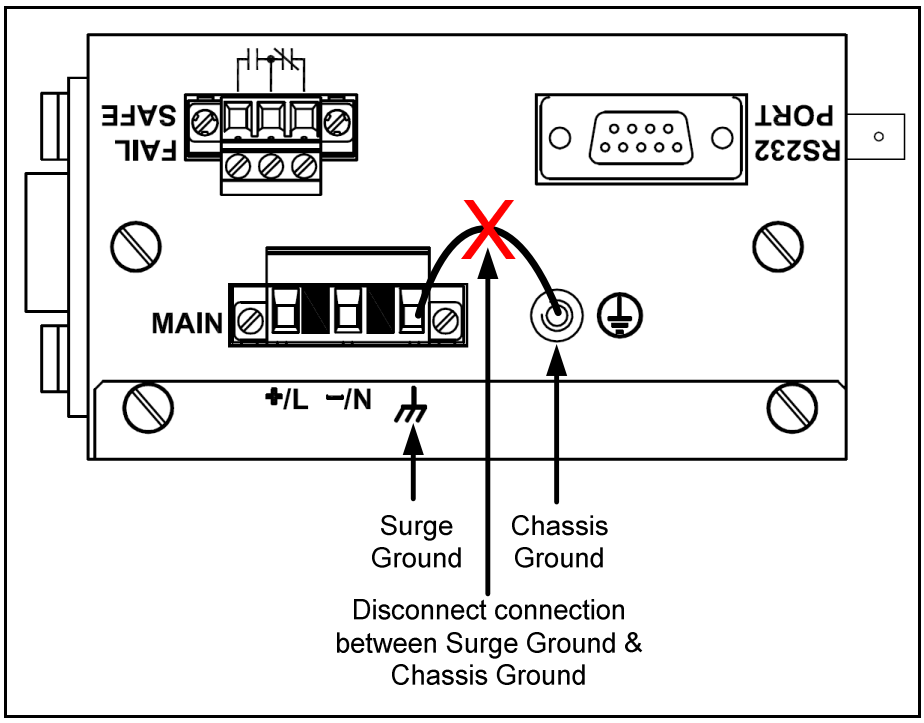

Figure 7 - Dielectric Strength Testing

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2.3 RS232 Console Port Wiring

The RS232 port is used for configuring the unit. A straight-through serial cable with a DB-9 connector is required. There is no need to crossover the Transmit and Receive signals from the PC side since this has been done internally as is shown below.

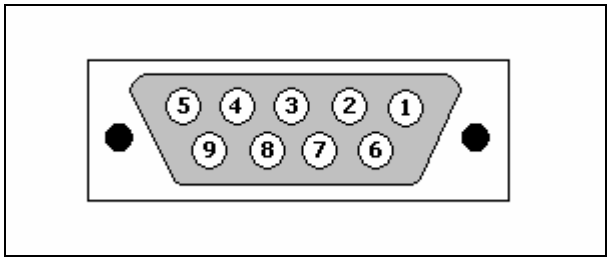

Figure 8 - RS232 Female DCE pin-out

Pin	*Signal*
1	No Connection
2	Transmit Data
3	Receive Data
4	No Connection
5	Ground
6	No Connection
7	No Connection
8	No Connection
9	No Connection

Table 2 - RS232 Female DCE pin-out

NOTE: This port is not intended to be a permanent connection and the cable shall be less than 2m (6.5 ft) in length.

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3 Ethernet Ports

3.1 RJ11 Ethernet over VDSL Port

3.1.1 Overview

The Ethernet over VDSL (EoVDSL) port on RS900L operates in pairs with one configured as the Master and the other as the Slave. In VDSL literature the terms Central Office (CO) or Line Termination (LT) are used interchangeably for the Master and the terms Customer Premise Equipment (CPE) or Network Termination (NT) are used interchangeably for the Slave. Configuration of Master or Slave mode is done through the RuggedSwitch Operating System.

The unit contains one EoVDSL data port that allows connection to Category 3 (CAT-3) unshielded twisted-pair (UTP) cable with RJ11 male connectors. The figure below shows the RJ45 port pin-out and LEDs.

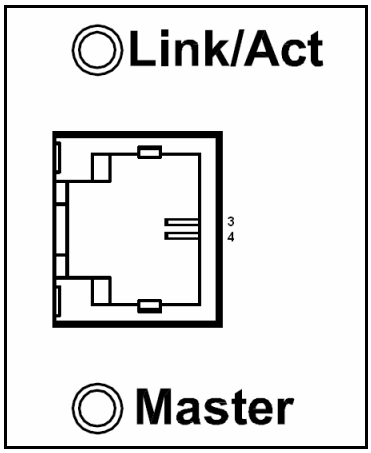

Figure 9 - RJ11 port pin-out and LEDs

Pin	*Signal*
3	Ring
4	Tip

Table 3 - RJ11 port pin-out

Status LED	*Colour*	*Activity*	*Comments*
Mode	Green	On	Master Mode
		Off	Slave Mode
Link / Act	Green	Solid	Link Established
		Blinking	Tx Activity

Table 4 - RJ11 port LED description

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3.1.2 Wiring

VDSL typically operates over 2-wire CAT-3 wiring; however, other categorized or uncategorized twisted-pair wiring will work although the performance will vary depending on the distance and cable characteristics. It is important that the wiring used does not have any open leads (also known as bridged taps or drop-lines) along its length because this will impact performance by degrading the signal.

3.1.3 Configuration & Setup

1. Log into the RuggedSwitch Operating System.
2. Highlight **Ethernet Ports** and press Enter.
3. Highlight **Configure/View EoVDSL Parameters** and press Enter. This will take you to the **EoVDSL Parameters** screen. Press Enter again.
4. Highlight Mode and press Enter.
5. Either press the Up or Down arrow to select either **Master** or **Slave**. Press Enter.
6. Press *Control* and *A* together to apply the changes.

Once configured as master and slave and connected together, the units will then attempt to achieve the maximum speed based on the line length and conditions. The unit's link LED may flash on and off several times before settling on a final link speed and declaring the port up. Please see the Rugged Operating System (ROS) Software User Guide for detailed software configuration options.

3.1.4 Performance

On 24 American Wire Gauge (AWG) Polyethylene Insulated Cable (PIC) twisted-pair the following performance is typical:

Distance [km]	*Distance [feet]*	*Downstream/Upstream [Mbps]*	*Time to Achieve Port Up [Seconds]*
0.5	1600	35.00	15
0.6	2000	30.00	30
0.7	2300	25.00	45
0.8	3000	20.00	60
1.0	3300	15.00	75
1.3	4300	10.00	90
1.7	5600	5.00	105
2.0	6600	2.50	120
2.5	8200	1.00	135

Table 5 - Typical Performance on 24 AWG PIC twisted-pair

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The unit can automatically select the best bit-rate based on current line conditions. If the line conditions degrade (reducing the SNR) but the unit is able to maintain the link, an alarm will be triggered to notify the user of the reduced SNR. If the line conditions degrade such that the unit is unable to maintain the current link, the unit will restart the scan process.

NOTES:

1. This port is designed to be used on private communications lines and is not to be connected to the Public Switched Telephone Network (PSTN).

2. To reduce the risk of fire, use only No. 26 AWG or larger telecommunication line cord.

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3.2 RJ45 Ethernet Ports

The RS900L has several 10/100Base-TX ports that allow connection to standard Category 5 (CAT-5) unshielded twisted-pair (UTP) cable with RJ45 male connectors. The RJ45 receptacles are directly connected to the chassis ground on the unit and can accept CAT-5 shielded twisted-pair (STP) cables. If shielded cables are used, care must be taken to ensure the shielded cables do not form a ground loop via the shield wire and the RJ45 receptacles at either end. The figure below shows the shows the RJ45 port pin-out and LEDs.

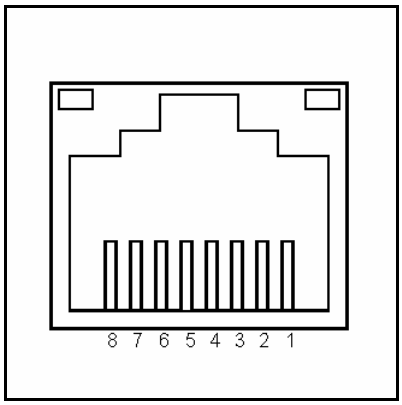

Figure 10 - RJ45 port pin-out and LEDs

Pin	Signal
1	+Rx
2	-Rx
3	+Tx
4	No Connection
5	No Connection
6	-Tx
7	No Connection
8	No Connection
Case	Shield (Chassis Ground)

Table 6 - RJ45 port pin-out

Status LED	Colour	Activity	Comments
Speed LED	Yellow	Off	10 Mbps
		On	100 Mbps
Link LED	Yellow	Solid	Link Established
		Blinking	Tx/Rx Activity

Table 7 - RJ45 port LED description

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NOTE: RuggedCom does not recommend the use of copper cabling of any length for critical real-time substation automation applications. However, transient suppression circuitry is present on all copper ports to protect against damage from electrical transients and to ensure IEC 61850-3 and IEEE 1613 Class 1 conformance. This means that during the transient event communications errors or interruptions may occur but recovery is automatic.

RuggedCom also does not recommended to use these ports to interface to field devices across distances which could produce high levels of ground potential rise, (i.e. greater than 2500V) during line to ground fault conditions.

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3.3 Fiber Optic Ethernet Ports

Depending on the order code of the product, the unit can be equipped with several different fiber optic ports. The Transmit (Tx) and Receive (Rx) connections of each port must be properly connected and matched for proper link and operation. The drawings in the following figures show each fiber optical connector style with a side and top view to allow the user to identify the proper cable connection orientation.

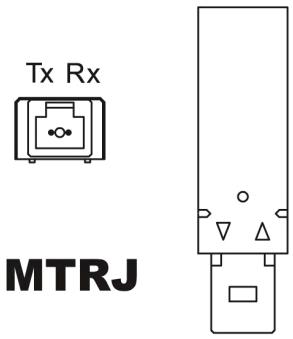

Figure 11 - 100FX MTRJ connector

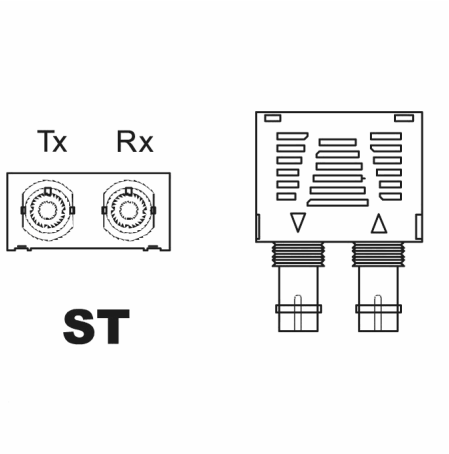

Figure 12 - 100FX ST connector

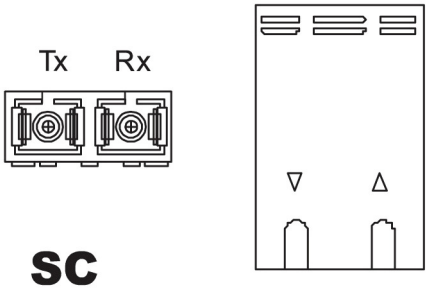

Figure 13 - 100FX SC connector

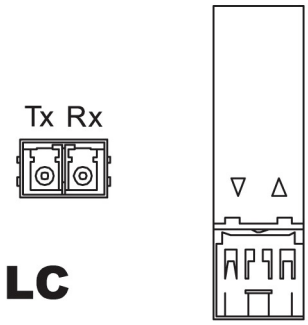

Figure 14 - 100FX LC connector

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4 Technical Specifications

4.1 Operating Environment

Parameter	Range	Comments
Ambient Operating Temperature	-40 to 85°C	Ambient Temperature as measured from a 30 cm radius surrounding the center of the enclosure.
Ambient Storage Temperature	-40 to 85°C	
Ambient Relative Humidity	5% to 95%	Non-condensing

Table 8 - Operating Environment

4.2 Power Supply Specifications

Power Supply Type	Minimum Input	Maximum Input	Fuse Rating	Isolation	Maximum Power Consumption
12 – 24 VDC	10 VDC	36 VDC	3.15 (T)	1.5 kV DC	10W
24 VDC	18 VDC	36 VDC	3.15 (T)	1.5 kV DC	
48 VDC	36 VDC	72 VDC	3.15 (T)	1.5 kV DC	
HI (125/250 VDC) 1 HI (110/230 VAC) 1	88 VDC 85 VAC	300 VDC 265 VAC	3.15 (T)	4 kV AC 5.5 kV DC	

Table 9 - Power Supply Specifications

NOTES:

1. This is the same power supply for both AC and DC.
2. (F) Denotes fast-acting fuse, (T) denotes time-delay fuse
3. For continued protection against risk of fire, replace only with same type and rating of fuse.

4.3 Failsafe Relay Specifications

Load Circuit	SELV		TNV-2
MAX operating Voltage	30VDC	30 VAC	80VDC
MAX operating Current	1A	0.5A	0.3A
Isolation (between coil and contacts)	1800 V_{rms}		

Table 10 - Failsafe Relay Specifications

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4.4 RJ11 Ethernet over VDSL Port Specifications

Data Port	Media	Distance	Connector Type
VDSL	CAT-3 UTP or STP	2500m	RJ11

Table 11 – RJ1 Ethernet over VDSL Port Specifications

4.5 RJ45 Ethernet Port Specifications

Data Port	Media	Distance	Connector Type
10/100 Mbps	CAT-5 UTP or STP	100m	RJ45

Table 12 – RJ45 Ethernet Port Specifications

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4.6 Fiber Optic Ethernet Port Specifications

Speed Standard	Mode / Connector	Tx λ (nm)	Cable Type[2] (μm)	Tx Pwr (dBm peak)[3] (Min / Max)	Rx Sensitivity (dBm Average)[3]	Rx Saturation (dBm Peak)[3]	Typical Distance (km)[1]	Power Budget (dB)
100Base-FX	MM / ST	1310	50/125	-15.7	-33.5	-11	2	17
100Base-FX	MM / SC	1310	50/125	-16/-11	-33	-11	2	17
100Base-FX	MM / LC	1310	50/125	-19 / -14	-32	-14	2	15
100Base-FX	MM / MTRJ	1310	50/125	-16/-11	-33.5	-11	2	17
100Base-FX	SM / ST	1310	9/125	-15/-8	-32	-7	20	16.5
100Base-FX	SM / SC	1310	9/125	-13/5	-31	-4	20	20
100Base-FX	SM / LC	1310	9/125	-15/-8	-31	-5	15	16.5

Table 13 - Fiber Optic Port Specifications

NOTES:

1. Maximum segment length is dependent on factors such as fiber quality, and number of patches and splices. Please consult RuggedCom sales associates when determining maximum segment distances.
2. To convert from average to peak add 3 dBm. To convert from peak to average, subtract 3 dBm.

4.7 Communication Standards

Protocol	Standards
Ethernet	IEEE 802.3
VDSL	ETSI TS 101 270-2 V1.1.1, ITU-T G.993.1, ANSI T1E1.4

Table 14 - Communication Standard Compliance

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4.8 Mechanical Specifications

Parameter	Value
Dimensions	16.8 x 11.7 x 6.6 cm / 6.6 x 4.6 x 2.6 inches
Weight	1.2 kg / 2.7 lbs
Enclosure	20 AWG Galvanized Steel

Table 15 - Mechanical Specifications

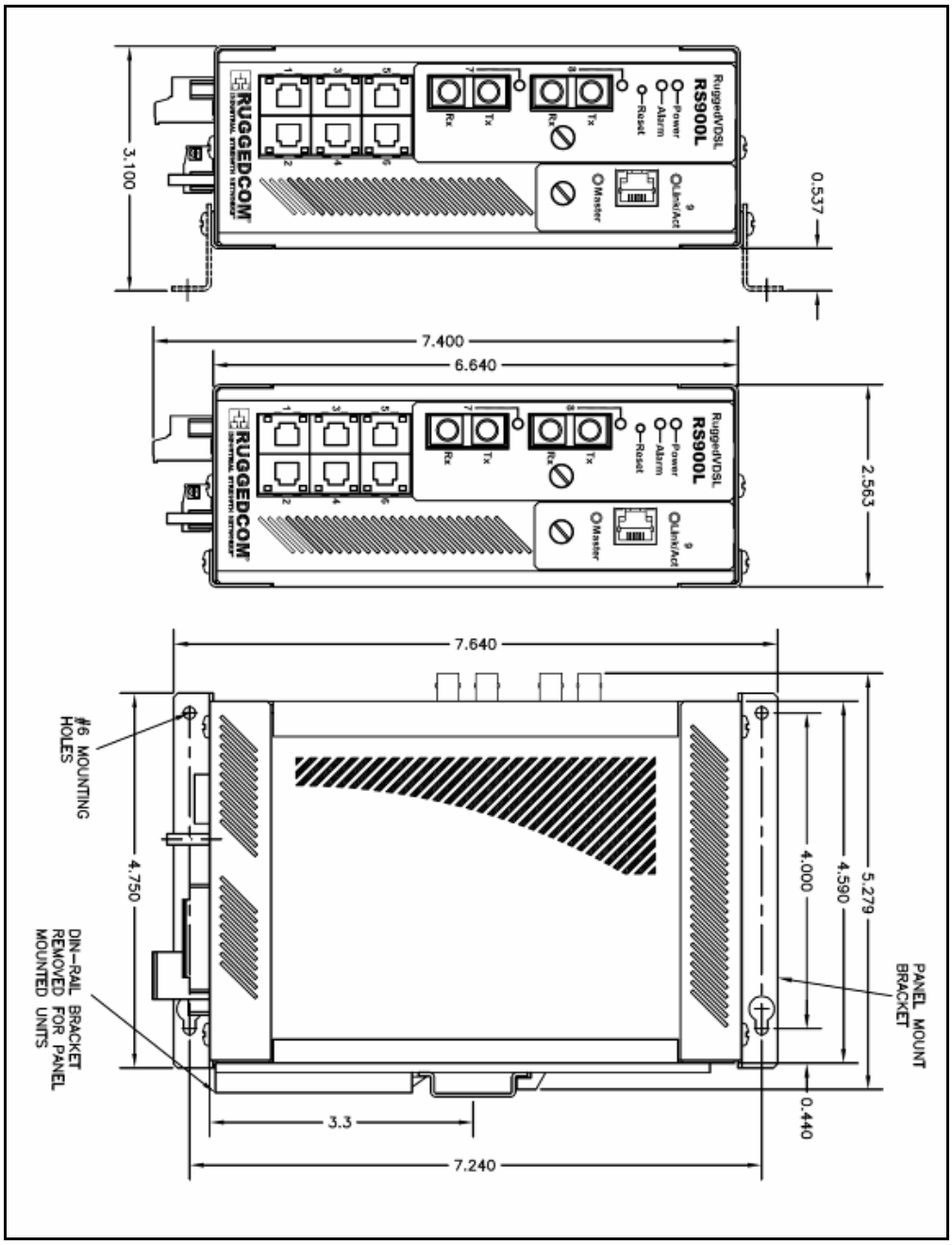

Figure 15 - Mechanical Specifications

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5 Type Tests

5.1 IEC 61850-3 Type Tests

Test	Description		Test Levels	Severity Levels
IEC 61000-4-2	ESD	Enclosure Contact	+/- 8kV	4
		Enclosure Air	+/- 15kV	4
IEC 61000-4-3	Radiated RFI	Enclosure ports	20 V/m	x
IEC 61000-4-4	Burst (Fast Transient)	Signal ports	+/- 4kV @ 2.5kHz	x
		D.C. Power ports	+/- 4kV	4
		A.C. Power ports	+/- 4kV	4
		Earth ground ports	+/- 4kV	4
IEC 61000-4-5	Surge	Signal ports	+/- 4kV line-to-earth, +/- 2kV line-to-line	4
		D.C. Power ports	+/- 2kV line-to-earth, +/- 1kV line-to-line	3
		A.C. Power ports	+/- 4kV line-to-earth, +/- 2kV line-to-line	4
IEC 61000-4-6	Induced (Conducted) RFI	Signal ports	10V	3
		D.C Power ports	10V	3
		A.C. Power ports	10V	3
		Earth ground ports	10V	3
IEC 61000-4-8	Magnetic Field	Enclosure ports	40 A/m continuous, 1000 A/m for 1 s	N/A
IEC 61000-4-29	Voltage Dips & Interrupts	D.C. Power ports	30% for 0.1s, 60% for 0.1s, 100% for 0.05s	N/A
		A.C. Power ports	30% for 1 period, 60% for 50 periods	N/A
IEC 61000-4-11			100% for 5 periods, 100% for 50 periods [2]	N/A
IEC 61000-4-12	Damped Oscillatory	Signal ports	2.5kV common, 1kV differential mode @ 1MHz	3
		D.C. Power ports	2.5kV common, 1kV differential mode @ 1MHz	3
		A.C. Power ports	2.5kV common, 1kV differential mode @ 1MHz	3
IEC 61000-4-16	Mains Frequency Voltage	Signal ports	30V Continuous, 300V for 1s	4
		D.C. Power ports	30V Continuous, 300V for 1s	4
IEC 61000-4-17	Ripple on D.C. Power Supply	D.C. Power ports	10%	3
IEC 60255-5	Dielectric Strength	Signal ports	2kV AC (Fail-Safe Relay output)	N/A
		D.C. Power ports	2kV AC	N/A
		A.C. Power ports	2kV AC	N/A
IEC 60255-5	H.V. Impulse	Signal ports	5kV (Fail-Safe Relay output)	N/A
		D.C. Power ports	5kV	N/A
		A.C. Power ports	5kV	N/A

Table 16 - IEC 61850-3 Type Tests

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5.2 IEEE 1613 Type Tests

Test	Description		Test Levels
IEEE C37.90.3	ESD	Enclosure Contact	+/- 8kV
		Enclosure Air	+/- 15kV
IEEE C37.90.2	Radiated RFI	Enclosure ports	35 V/m
IEEE C37.90.1	Fast Transient	Signal ports	+/- 4kV @ 2.5kHz
		D.C. Power ports	+/- 4kV
		A.C. Power ports	+/- 4kV
		Earth ground ports	+/- 4kV
IEEE C37.90.1	Oscillatory	Signal ports	2.5kV common mode @ 1MHz
		D.C. Power ports	2.5kV common & differential mode @ 1MHz
		A.C. Power ports	2.5kV common & differential mode @ 1MHz
IEEE C37.90	H.V. Impulse	Signal ports	5 kV (Failsafe Relay)
		D.C. Power ports	5 kV
		A.C. Power ports	5 kV
IEEE C37.90	Dielectric Strength	Signal ports	2kV AC(Failsafe Relay)
		D.C. Power ports	2kV AC
		A.C. Power ports	2kV AC

Table 17 - IEEE 1613 Type Tests

NOTE:

- If the unit contains copper ports the IEEE 1613 conformance is Class 1 (During disturbance errors may occur but recovery is automatic).
- If the unit contains all fiber ports the IEEE 1613 conformance is Class 2 (During disturbance no errors will occur).

5.3 IEC Environmental Type Tests

Test	Description		Test Levels	Severity Levels
IEC 60068-2-1	Cold Temperature	Test Ad	-40 deg. C, 16 Hours	N/A
IEC 60068-2-2	Dry Heat	Test Bd	+85 deg. C, 16 Hours	N/A
IEC 60068-2-30	Humidity (Damp Heat, Cyclic)	Test Db	95% (non-condensing), 55°C, 6 cycles	N/A
IEC 60255-21-1	Vibration	Tests Fc	2g @ (10-150) Hz	Class 2
IEC 60255-21-2	Shock	Tests Ea	30g @ 11 ms	Class 2

Table 18 - Environmental Type Tests

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6 Warranty

RuggedCom warrants this product for a period of five (5) years from date of purchase. For warranty details, visit http://www.ruggedcom.com or contact your customer service representative. Should this product require warranty or service contact the factory at:

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30 Whitmore Road,
Woodbridge, Ontario
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